# EPA's New Mobile Source Emissions Model: Progress and (Some) Proposals

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#### We Need A Name!!!

- "New Generation Model" really tired
- "Name The Model" contest
- Submit entries to newgen@epa.gov
- No obscenities

#### **Progress Thus Far...**

- Issue Paper published May 2001
- Conceptual design developed
- Top-level software design contract underway
- On-board emission data pilot study underway
- Project plan and schedule developed

#### **Design Steps**

- Design contract with MCNC
- Step 1: Develop "Use Cases"
  - → What specific uses should the design address?
  - → Who will use the model for these purposes?
- Step 2: Design
  - → Translate conceptual design to object-oriented software design
  - → Role of EPA MIMS framework will be determined

#### **Use Cases Under Consideration**

- National inventory development
  - → Regulatory support
  - → Trends
  - → Greenhouse Gases Sources & Sinks
- Legislative analyses
  - → SIP inventories & ROPs
  - → Conformity analyses
- International use
- Microscale analyses
  - → PM/CO Conformity
  - → Toxics "hot spots"

#### Use Cases, cont.

- Policy evaluation
  - → New standards/technology
  - → New fuels
  - → Reducing VMT
  - → Reducing in-use emissions
- Interface with transportation models
  - → TRANSIMS
  - → 4-step TDMs & post-processors
  - → Microscopic transportation models (e.g. PARAMICS, CORSIM)
- Interface with emission processors
  - $\rightarrow$  EMS
  - → SMOKE (MODELS3)

#### Use Cases, cont.

- Interface with dispersion models (CAL3QHC)
- Validation
  - → Individual components & entire model
- Uncertainty analyses
  - → Options: error propagation, Monte Carlo, bootstrap
  - → Each have design considerations
- Sensitivity analyses
  - → Determining important inputs
  - → Finding performance shortcuts
  - → Input for research priorities
- Model expansion and updates

# Use Case Issues for Workgroup Consideration

- Are the use cases characterized correctly?
- Is anything missing from this list?
- Approaches for validation & uncertainty
- Frequency of model updates
- User interface preferences
- Desire for "intermediate" estimates (e.g. emission factors, not total emissions)

## **Design Concepts**

- What is important for estimating emissions:
  - → How many emission sources?
  - → What type are they?
  - → What are they doing?
  - → What are the emissions associated with what they are doing?
- These questions apply regardless of source, scale, or pollutant
- Conceptual design focused on these questions

## **Conceptual Design**

- Core model provides system for calculating emissions
  - → Generic structure
  - → Applicable across scale, pollutant, source
- "Implementations" provide fleet & activity content
  - → EPA will develop national inventory implementation
  - → Mesoscale and microscale implementations would be developed by users within NGM framework using EPA guidance
    - Could rely on many of the defaults from national inventory implementation

# **Core Model Design**

#### Fleet

→ <u>Population</u> of vehicle/equipment types with similar emission characteristics <u>by space & time</u>

#### Activity

- → Fraction of time spent in operating modes by space & time
- → Frequency of events important to emission production

#### Emission rates

→ Emissions <u>per time</u> for each combination of fleet bin and operating mode, accounting for events important to emission production

#### Total emissions by space & time

[ $\sum$  (Population <sub>BIN</sub> \* Fraction of Time <sub>MODE</sub> \* Emission Rate <sub>BIN, MODE</sub>)] \* Time

#### Implementation Process: Fleet

- Raw counts
  - → Macroscale
    - HPMS
    - Surveys and allocation (nonroad)
  - → Mesoscale/Microscale
    - Travel models
    - Observation
    - Surrogate relationships (nonroad equipment)
- Disaggregation into emission bins
  - → Vehicle registration
  - → Emitter distribution
  - → Technology/standard distribution
  - → Power and weight distributions

## **Implementation Process: Activity**

- Fraction of time operating
  - → on-road: function of average speed and miles traveled
  - → off-road: surveys, on-board measurement
- Fraction of time in operating modes
  - → e.g. idle, stable load, increasing load, decreasing load
  - → Map to average speed, roadway type, volume/capacity
  - → Data sources: driving surveys/cycles, observation, on-board
- Probability of emission "mechanism"
  - → e.g. start, enrichment, a/c on, hot soak
  - → Data sources: ambient conditions, driving surveys, on-board, travel models

#### **Emission Rates**

- Emissions <u>per time</u> for each combination of fleet bin and operating mode, accounting for events important to emission production
- Would be the same for all implementations
- Will consider fuel consumption as the basis of exhaust emission rates
- Options for emission rate disaggregation:
  - → Pre-determine fleet bin and operating mode breakdowns
  - → Let data determine what bins and modes are important
    - Will vary by source and pollutant

### **Software Implications**

- Conceptual design fits well in object-oriented design approach
- Benefits of Object-Oriented design:
  - $\rightarrow$  Form of solution fits form of problem  $\rightarrow$  SIMPLICITY
  - → Consistent with goals of modularity & flexibility
- New language would be required
  - → Java or C++

# Design Issues for Workgroup Consideration

- Population and time basis, <u>not</u> VMT
  - → Would have to translate from one to the other
- Modal emission basis for all scales
- Total emission calculation capability
- Software language change
- Basing exhaust emission rates on fuel consumption

# Proposed Project Plan - Implementation Phases

- Fuel Consumption Model
  - → On-road and off-road sources
  - → Allows validation step
  - → Foundation for all other pollutants
- Greenhouse Gas Model
  - → On-road and off-road sources
  - → Includes HFCs
- All Other Pollutants
  - → MOBILE and NONROAD replacements
- Integration with MODELS-3 & TRANSIMS

# **Proposed Project Schedule**

<u>Milestone</u>	<b>Projected Date</b>
Comprehensive Plan Drafted	Jun 02
Fuel Consumption Model	Aug 03
Greenhouse Gas Model	Jun 04
All Other Pollutants	Nov 05

# Implementation Plan Issues for Workgroup Consideration

- Implementation phases and schedule
- Validation using fuel sales data

## Workgroup Next Steps

- Workgroup provides comments and recommendations to EPA on:
  - → Use Cases
    - Review MCNC use-case documentation
  - → Conceptual Design
  - → Implementation Schedule
- Focus on issues raised in this presentation
- Report back to EPA by end of 2001
- Recommendation to MSTRS in February
- Need a workgroup member to coordinate this

#### **On-Board Data Analysis**

- How can on-board data be used in NGM?
- Analysis "shootout" contract:
  - → Develop conceptual methodology
  - → Demonstrate on pilot dataset
  - → Recommend role of alternate data
  - → Recommend sampling plan
- Awardees: Ga Tech, NC State, UC Riverside
- Complete work January 2002

## **EPA Pilot Test Program**

#### 18 Light-Duty Vehicles

- → 17 Tier 1, 1 LEV
- → Sensors, Inc. SEMTECH-G
- → HC, CO, NO, CO<sub>2</sub>, OBD parameters, GPS, Ambient
- → FTP & US06 correlation

#### 15 Transit Buses

- → 1995-97 Detroit Diesel Series 50 III w/ Catalyst
- → Sensors. Inc. SEMTECH-D
- → HC, CO, NO, NO<sub>2</sub>, CO<sub>2</sub>, engine parameters, GPS, ambient

#### 15 Off-Road Equipment

- → Diesel agricultural and construction equipment ≈ 150-300 hp
- → EPA "SPOT" (ne PEMS) unit
- → NO, NO<sub>2</sub>, CO<sub>2</sub>, RPM, GPS, ambient